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OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

PC Code 129086

DRINKING WATER ASSESSMENT

SUBJECT: Tier 1 Screen for Drinking Water Assessment for Phostebupirim
PC Code 129006: CAS # 96182-53-5

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This memorandum presents results of a tier 1 drinking water assessment for phostebupirim, also commonly referred to as tebupirimphos or MAT 7484 (O-[2-(1,1-dimethylethyl)-5-pyrimidinyl] O-ethyl-(1-methylethyl) phosphorothioate). The GEENEC model was used to estimate screening concentrations of phostebupirim in drinking water from surface water sources. The SCI-GROW model was used to estimate screening concentrations of phostebupirim from ground water sources.

Phostebupirim Use

The maximum application rate recommended on the label by Bayer Corporation, the manufacturer of AZTEC 2.1% granular formulation of phostebupirim, is 7.3 pounds per acre per crop season. This corresponds to a rate of application of 0.153 pounds of phostebupirim per acre per crop season. One crop season per year was assumed. AZTEC 2.1 % granular insecticide is recommended to be applied in bands, t-bands, and in-forrow. Recommended crops include field corn, sweet corn, popcorn, and corn grown for seed or silage. This formulation is intended to control corn rootworm larvae, cutworms, wireworms, seedcorn maggot, seedcorn beetle, and white grubs.

Environmental Fate

Environmental fate data and physical/chemical properties used for phostebupirim in the screening drinking water assessment are summarized in Table 1. Based on available data regarding half-lives under environmental conditions, phostebupirim appears to be quite persistent in the environment. Based on the relatively high k_{ad} values determined, phostebupirim also appears to be quite immobile in soil. Two metabolites of phostebupirim were confirmed in a soil metabolism study completed by Bayer Corporation on May 14, 1997. These two metabolites, TBHP (2-[1,1-dimethyllethyl]-5-hydroxypyrimidine) and OMAT (2-[1,1-dimethylethyl]-5-pyrimidinyl ethyl 1-methylethyl phosphate), as well as other nonspecified degradates, were reported to account individually for no more than ten percent of the applied radioactivity. The OMAT metabolite is structurally very similar to phostebupirim. The oxygen analog of phostebupirim, OMAT, appears to be quite mobile, however, based on reported k_{ad} values ranging from 1.4 to 3.6.

A previous aerobic soil metabolism study using a sandy loam soil from Howe, IN indicated a soil half-life of 343 days (Kao et al. 1990). Two field dissipation studies performed at two locations with different soil characteristics than the soil in the Kao et al. (1990) study indicated much shorter soil half-lives, ranging from 14 days in Linder sandy loam soil from Hollandale, MN (Valadez et al. 1994) to 39 days in Sparta loamy sand soil from Genesco, IL (Dehart et al. 1994). The purpose of a recent aerobic soil metabolism study (Cink et al. 1997) was to determine the disparity in the half-life values between the previous aerobic soil metabolism study (Kao et al. 1990) and the two field dissipation studies (Valadez et al. 1994; Dehart et al. 1994). Differences in the half-life values between the aerobic soil metabolism study and the two field dissipation studies were thought to be attributed to differences in application rate and soil characteristics. The test concentration in the previous aerobic soil metabolism study (Kao et al. 1990) was 34 times greater than the concentration that corresponds to the current maximum label application rate of 0.153 pounds of active ingredient per acre. The Bayer Corporation decided to perform a new study that provided aerobic soil metabolic half-life results at the maximum label application rate for all three soil types examined in the Kao et al., Dehart et al., and Valadez et al. studies and also included results for all three soil types at 10 and 100 times the maximum recommended application rate for the AZTEC 2.1% granular formulation. The Bayer Corporation has been asked to provide additional information on the Cink et al. (1997) study. Final approval of the Cink et al. (1997) study by the Agency is contingent upon the responses received.

An aerobic soil metabolic half-life of 343 days was selected as an input for estimating screening surface water and ground water concentrations. This half-life was the aerobic soil metabolic half-life determined for the soil type in the Cink et al. (1997) study that exhibited the least potential for aerobic metabolism (i.e., Sparta loamy sand soil from Genesco, IL) and for an application rate that corresponds to the maximum label application rate. An aerobic soil metabolic half-life of 55 days was the half-life for the soil type that exhibited the greatest potential for aerobic metabolism (i.e., sandy loam soil from Howe, IN) at an application rate that corresponds to the maximum label application rate. A previous study by Kao et al. (1990) also reported a soil metabolic half-life of 343 days, but for sandy loam soil from Howe, IN at an application rate 34 times greater than the maximum application rate on the product label. Given the study conditions that resulted in an aerobic soil metabolic half-life of 343 days, selecting an aerobic soil metabolic half-life of 343 days as an input to the GENEEC and SCI-GROW models provides a conservative estimate of concentrations of phostebupirim in ground water and surface water.

The photolytic half-life of phostebupirim was reported to be 31 hours in the aqueous environment and 106 days in soil in natural sunlight. The major degradate was reported to be DBMAT (O-ethyl O-(1-methylethyl) O-(5-pyrimidinyl) phosphorothioate). Minor degradates identified included TBHP in both aqueous and soil environments and DIMAT (O-[2-(1,1-dimethylethyl)-5-pyrimidinyl] O-ethyl O-hydrogen phosphorothioate) and OMAT in the aqueous environment. DIMAT was reported to be the major degradate that resulted from hydrolysis of phostebupirim.

TABLE 1. Environmental Fate Date and Physical/Chemical Properties Used in the Drinking Water Assessment for Phostebupirim

PROPERTY	RANGE	MODEL INPUT VALUE	MODEL
Solubility in water	5.5 ppm	5.5 ppm	GENEEC
Hydrolysis half-life	45 days at pH 7	45 days at pH 7	GENEEC
Photolysis half-life in water	31 hours	31 hours	GENEEC
Aerobic soil metabolic half-life at maximum label application rate	55 days to 343 days, depending on soil type[1]	343 days	GENEEC/SCI-GROW
Anaerobic soil metabolic half-life	279 days	not considered	
Aquatic aerobic metabolic half-life	no data	not considered	
K_{ad}	12.4 to 15.6	See K_{oc}	
K_{oc}	1022 to 2673	1022 (1710)	GENEEC (SCI-GROW)

[1] The half-life of 55 days is based on a study performed at the maximum label application rate on sandy loam soil from Howe, IN (Cink et al. 1997). The half-life of 343 days is based on a study performed at the maximum label application rate on Sparta loamy sand soil from Genesco, IL (Cink et al. 1997) and on a study performed at 34 times the maximum label application rate on

sandy loam soil from Howe, IN (Kao et al. 1990).

Surface Water Modeling

The GENEEC (Generic Estimated Environmental Concentration) model (EPA 1995), a surface water screening model developed by the Environmental Fate and Effects Division (EFED) of the Office of Pesticide Programs (OPP), was used to estimate surface water concentrations resulting from use of phostebupirim. GENEEC is capable of modeling a single runoff event and accounting for spray drift from multiple applications of non-granular pesticide formulations. The scenario that GENEEC models is a 10-hectare field immediately adjacent to a 1-hectare pond that is two meters deep and has no outlet. The runoff event transports a maximum of ten percent of the applied pesticide into the pond. The amount of applied pesticide that is predicted by GENEEC to be transported by way of runoff into the adjacent pond is determined by the extent to which a pesticide undergoes degradation and adsorption in the field.

GENEEC has some limitations as a predictive tool for drinking water assessments. Drinking water from surface water sources tend to originate from bodies of water that have considerably more volume than the pond depicted in the GENEEC scenario. In addition, GENEEC assumes that the entire basin receives an application of the pesticide. Usually, basins large enough to support a drinking water facility will include a substantial fraction of area that does not receive the pesticide. Furthermore, GENEEC overestimates the persistence of the pesticide near the drinking water facility since it does not account for turn-over that can occur in a pond or lake or for the water flow that serves to dilute pesticide in a river environment. Despite these limitations, GENEEC provides an upper bound estimate of the concentration of a pesticide that potentially can occur in surface water prior to drinking water treatment and is, therefore, appropriate for screening calculations. If a risk assessment performed using surface water concentrations predicted from GENEEC does not exceed levels of concern for a pesticide , then there is high confidence that the risk for this pesticide will also be below the level of concern. Since GENEEC may substantially overestimate actual drinking water concentrations, it will be necessary to refine the GENEEC scenario if the level of concern is exceeded.

The GENEEC model was run for a range of K_{oc} values, aerobic soil metabolic half-lives, and depths of incorporation corresponding to the types of application recommended on the product label. Based on product label information, the phostebupirim formulation was assumed to be granular and applied at a rate of 0.153 pounds of phostebupirim per acre annually. Since the formulation is granular, no spray drift was assumed to occur. The highest concentrations of phostebupirim estimated in surface water were based on a K_{oc} of 1022, a 0-inch depth of incorporation of formulation, and an aerobic soil metabolic half-life of 343 days. These highest estimated concentrations of phostebupirim in surface water were a peak concentration of 1.89 acute surf ppb, an average 4-day concentration of 1.79 ppb, an average 21-day concentration of 1.35 ppb, and average 56-day concentration of 0.86 ppb.

chronic surface

Ground Water Modeling

The SCI-GROW (Screening Concentration in Ground Water) model, a ground water screening model developed by OPP/EFED (Barrett 1997), was used to estimate ground water concentrations resulting from use of phostebupirim. The SCI-GROW model is based exclusively on maximum ground water concentrations from studies conducted at sites and under conditions which are most likely to result in ground water contamination. The ground water concentrations generated by SCI-GROW are based on the largest 90-day average recorded during the sampling period. Given these circumstances, it is quite unlikely that actual ground water concentrations based on these environmental conditions could exceed the SCI-GROW estimates. Also, since there is very little temporal variation in ground water concentrations compared to surface water concentrations, the resulting estimated concentrations can be considered as acute and chronic values. It should also be noted that the SCI-GROW model automatically predicts a screening concentration of 0.006 ppb for immobile chemicals (i.e., those chemicals with an associated value of K_{oc} greater than 9995).

Based on a median K_{oc} value of 1710, a aerobic soil metabolic half-life of 343 days, and an annual application rate of 0.153 pounds of active ingredient per year, a screening concentration of phostebupirim in ground water was estimated using the SCI-GROW model to be 0.3 ppb.

acute + chronic ground

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